



## DC Pro 3: Tools to Profile and Assess Data Center Energy Efficiency

**Sean Morash, Energetics**

**Dale Sartor, LBNL**

**Neil Wright, Kemtah**

**Garrett Speck, Kemtah**

April 14, 2015

**Welcome! This Webinar will give some background for the development of the Data Center Profiler tool and the team that will be maintaining it before demonstrating the updates to the tool.**

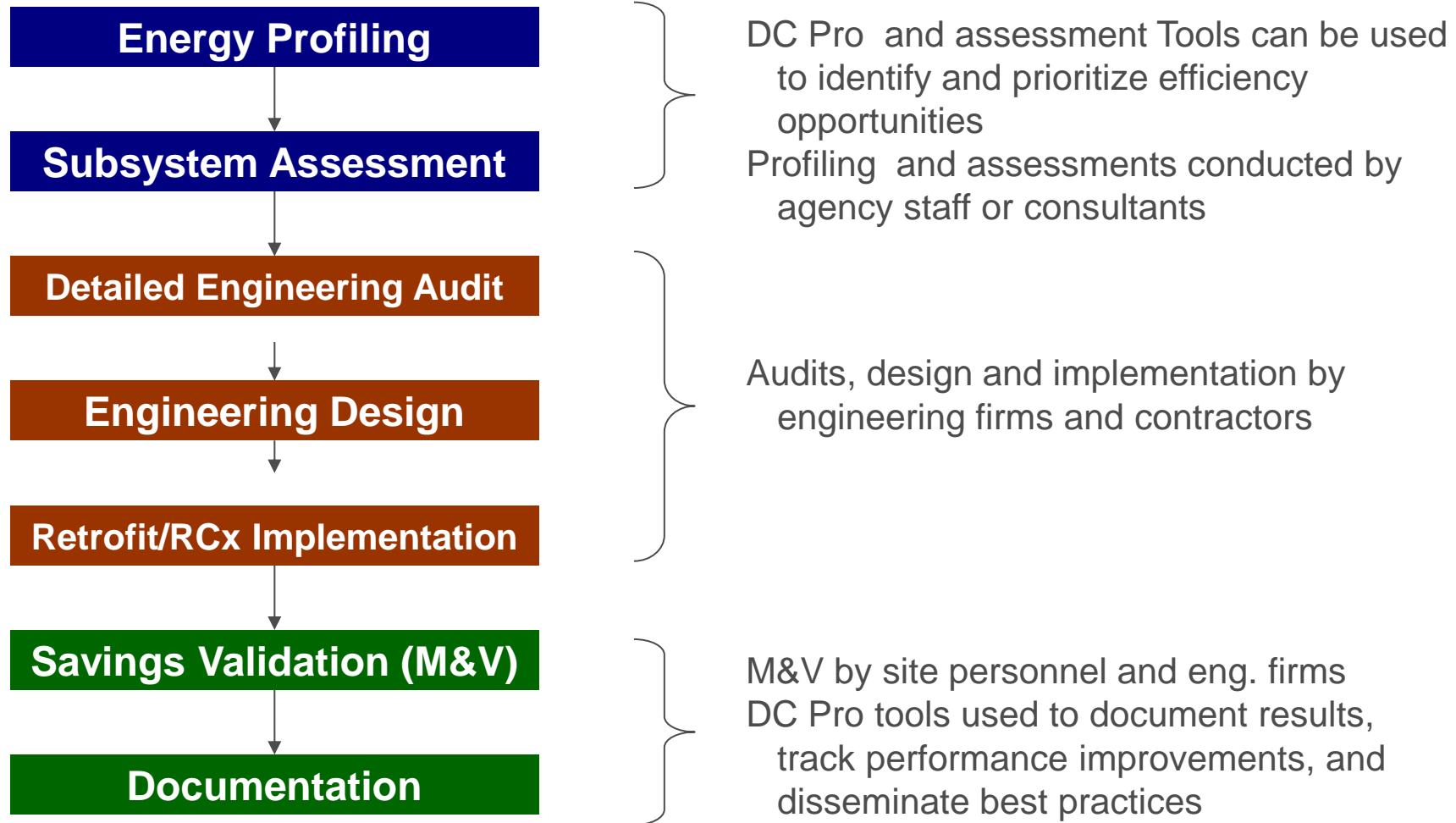
**<http://vsecorp.adobeconnect.com/dcprov3-webinars/>**

**Call in: 1-888-513-3298**

**Passcode: 02734184**

Before we begin:

- Please do NOT put the call on hold.
- All lines have been muted. To unmute yourself, press \*1, or submit questions through the chat dialogue box.



- Sponsored by the U.S. Department of Energy
- Core Development Team for DCPPro 3
  - LBNL
  - ANCIS
  - Integral Group
  - Kemtah (software)
- Wide array of reviewers
  - Data center owners
  - Design professionals
  - Product manufacturers

## INPUTS

Description

Utility bill data

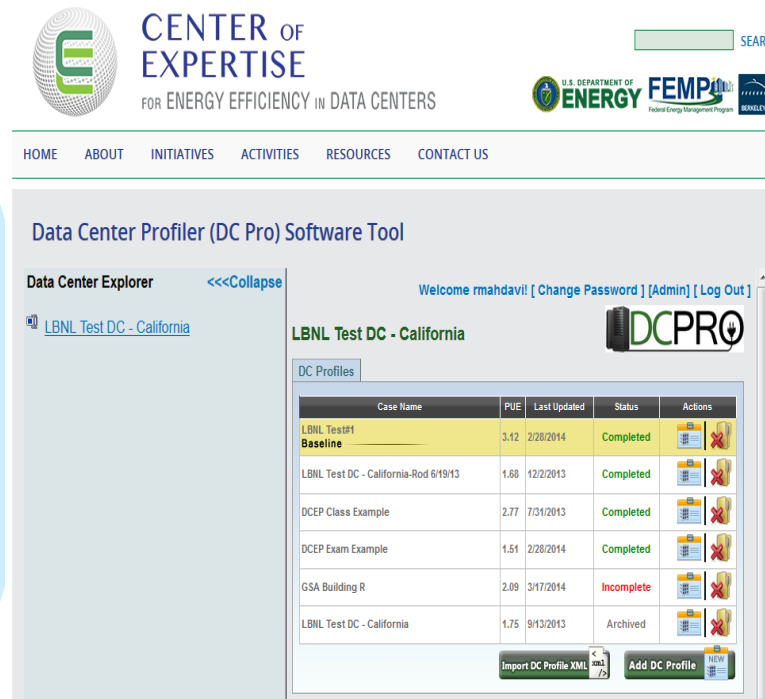
System information

IT

Cooling

Power

On-site gen



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Data Center Profiler (DC Pro) Software Tool

Data Center Explorer <<<Collapse

LBNL Test DC - California

LBNL Test DC - California

DC Profiles

Case Name	PUE	Last Updated	Status	Actions
LBNL Test DC Baseline	3.12	2/28/2014	Completed	[Icons]
LBNL Test DC - California-Rod 6/19/13	1.68	12/2/2013	Completed	[Icons]
DCEP Class Example	2.77	7/31/2013	Completed	[Icons]
DCEP Exam Example	1.51	2/28/2014	Completed	[Icons]
GSA Building R	2.09	3/17/2014	Incomplete	[Icons]
LBNL Test DC - California	1.75	9/13/2013	Archived	[Icons]

Import DC Profile XML Add DC Profile

## OUTPUTS

Overall efficiency (PUE)

End-use breakout

Potential areas for energy efficiency improvement

Overall energy use reduction potential

- **Profiling Tool:** Profiling
  - Establish baseline and efficiency potential
  - Document recommended actions and potential savings
  - Few hours effort for data entry
- **Assessment tools:** More detailed sub-system assessments
  - Air management and power chain tools to address major sub-systems
  - Provides savings estimates for efficiency actions
  - 3-5 day effort

More accurate overall energy performance (baseline)  
of data center

A list of energy efficiency actions



***Air management***

Environmental  
Criteria  
Configuration



***Power Chain***

UPS  
Distribution



***Future Tools***

IT  
HVAC

- All input data is treated as confidential.
- DC Pro aggregated and anonymous data can be used to inform DOE on the uptake of best practices in the industry.
- Your data is not available to other users.

# Center of Expertise Site

<http://datacenters.lbl.gov>

## DC Pro Profiling Tool

<http://datacenters.lbl.gov/dcpro/>

## Data Center Assessment Tools

<http://datacenters.lbl.gov/tools>

## FEMP Data Center Website

[http://www1.eere.energy.gov/femp/program/data\\_center.html](http://www1.eere.energy.gov/femp/program/data_center.html)



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"While information technology (IT) is improving the efficiency of government, energy use in data centers is growing at a significantly faster rate than any other building segment..."



A new Department of Energy-led CENTER of EXPERTISE will demonstrate national leadership in decreasing the energy use of data centers. The Center will partner with key influential public and private stakeholders. It will supply know-how, tools, best practices, analyses, and the introduction of technologies to assist Federal agencies with implementing policies and developing data center energy efficiency projects.



## Initiatives

The Data Center Energy Challenge will require participating Federal agencies and other data center owners to establish an efficiency goal for their data centers...

[MORE DETAILS](#)



## Resources

The Center's activities will include establishing metrics, providing technical assistance to agencies piloting innovative measurement and management approaches...

[MORE DETAILS](#)



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### All Initiatives

Data Center  
Energy Challenge

Measure &  
Manage

## Initiatives

### Data Center Energy Challenge

The Challenge will focus on improving the energy efficiency of core Federal enterprise data centers by 20% by 2020 through the implementation of best practices, including improvements when consolidating non-core centers.

### Measure and Manage

The Measure and Manage Initiative encourages data center stake holders to overcome barriers related to benchmarking energy use and equipment utilization within data centers.



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All Initiatives

**Better Buildings  
Data Center Energy  
Challenge**

Measure &  
Manage



## Better Buildings Data Center Energy Challenge

The Better Buildings Data Center Energy Challenge will require participating Federal agencies and other data center owners to establish an efficiency goal for their data centers, and to report and improve upon their performance, through metrics, such as Power Utilization Effectiveness (PUE). The Challenge will focus on improving the energy efficiency of core Federal enterprise data centers by 20% by 2020 through the implementation of best practices, including improvements when consolidating non-core centers. The Center of Expertise will provide implementation guidance to Federal Agencies on best practices. It will: set up a protocol to track progress, analyze the progress, and make recommendations for improvements. The Center of Expertise will work to develop capacity within private industry to provide tools useful to both the Federal and private sectors that answer the Challenge.



The Center of Expertise will be located at the Lawrence Berkeley National Laboratory (LBNL). LBNL has long been recognized by industry as a leading source for technical expertise on energy efficiency in data centers. The Center will partner with public and private organizations to advance joint initiatives benefiting both sectors; whereby the adoption and deployment of energy efficient technologies and best practices serves as a "new normal" for data center facilities managers.

If the same best practices are adopted across the country, the estimated benefit would be an avoided 12 billion KWh/year. To embark on these prospective savings, the Center of Expertise is planning two initiatives for FY 2013-2014, the Data Center Energy Challenge and a Measure and Manage Energy Program

### Links:

[DOE Better Buildings Data Centers Challenge](#)

## ***Data Center Partners in the Better Buildings Challenge***



The Partnership focuses on improving the energy efficiency of data centers by at least 20% within 10 years through the implementation of best practices, including improvements when consolidating.

Challenge site:

<http://datacenters.lbl.gov/initiatives/data-center-energy-challenge>

For more information contact Sean Morash at  
[sean.morash@ee.doe.gov](mailto:sean.morash@ee.doe.gov)

# DCPro3

## Tools to Profile and Assess Data Center Energy Efficiency

### Tool Demonstration

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Neil Wright  
Kemtah Inc.

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- ☐
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- ☐
- Power

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- Tools

**Apply****Reset****Title****Files and Links**

[Direct Liquid Cooling For Electronic Equipment](#)  
Report on the demonstration of direct liquid cooling for electronic equipment. Cisco C200 M3 servers were retrofitted with the Asetek direct cooling technology.

[Direct Liquid Cooling](#)

[Data Center Profiler Offline Executable](#)

[DCProOffline.exe](#)

[Best Practices for Data Center Energy Efficiency - Bangalore, India 2012](#)

[Sartor 9-20-2012](#)

[Federal Energy Management Program \(FEMP\) Data Centers](#)

[FEMP Data Centers](#)

[Worldwide Electricity Use in Data Centers](#)  
This study estimates historical electricity used by data centers worldwide and regionally on the basis of more detailed data than were available for previous assessments, including electricity used by servers, data center communications, and storage eq

[Data Center Energy Use 2008](#)

[PUE: A Comprehensive Examination of the Metric](#)  
This document allows executives to gain a high level of understanding of the concepts surrounding PUE, while providing in-depth application knowledge and resources to those implementing and reporting data center metrics.

[The Green Grid - Examination of PUE](#)



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## Tools

### Assessment Resources

These assessment resources are designed to help data center professionals identify energy-saving measures that are most likely to yield the greatest energy savings.

### Data Center Maturity Model Assessment Tool

The Data Center Maturity Model (DCMM) touches upon every aspect of the data center including power, cooling, compute, storage, and networking. In addition, the levels of the model outline current best practices and a 5-year roadmap for the industry.

### Datacenter Electrical Power Chain Assessment Tool

This tool is designed to help datacenter owners assess the potential savings from efficiency actions in the electrical power chain of a data center i.e. transformers, generators, UPSs, PDUs, and power supplies.

### Free Cooling Calculator

Based on environmental factors, and variables related to datacenter cooling infrastructure and IT energy use, this tool calculates potential savings attributable to the use of free cooling.

### Data Center Air Management Tool

Air management in Data Centers is important for both energy and thermal management.

### Data Center Profiler

Companies can use the Data Center Profiler (DC Pro) to identify and evaluate energy efficiency opportunities in data centers.

### ENERGY STAR Portfolio Manager

Benchmarking the energy performance of your buildings is a key first step to understanding and reducing energy consumption and your carbon footprint.

# Data Center Profiler (DC Pro) Software Tool

[ [Log In](#) ]

The Data Center Profiler (DC Pro) Software Tool can be used by federal agencies to identify and evaluate energy efficiency opportunities in data centers. DC Pro features advanced data center profiling algorithms and system assessment tools developed in conjunction with data center experts at Lawrence Berkeley National Lab that allow users to perform energy assessments on specific areas of a data center.

## DC PRO HIGHLIGHTS



### Data Center Energy Profiles

Identify and evaluate opportunities for improved energy and operational efficiency in data centers.



### Estimate Data Center PUE

Generate Power Usage Effectiveness (PUE) estimates to assist with data center benchmarking and optimization.



### Optimization Recommendations

Generate a list of project recommendations that provide guidance on data center best practices.



### Cost Savings

Assess energy-related cost savings opportunities and prioritize based on ROI indicators for economic, environmental or social benefits.



### Federal Compliance

Address federal agency compliance requirements associated with EO 13514 and Federal Data Center Optimization.



Start your DC Pro assessment by registering with a FEMP administrator below.

## GET STARTED



[DC Pro / Data Center Energy Practitioner Courses, Seminars, and Webinars](#)



[Login or Register and begin using DC Pro](#)

## RESOURCES

- [User Manual](#)
- [Training Presentation](#)
- [DC Pro Master List of Actions](#)
- [DC Pro Calculations Manual](#)



## DOE DC-Pro3 Profiling Tool for Data Centers: User's Manual

Version 4.0 (November 07, 2014)

The User's Manual and the DC-Pro tool were developed by Lawrence Berkeley National Laboratory (LBNL) for the US Department of Energy (DOE)

For questions and additional information, contact the *Center of Expertise for Energy Efficiency in Data Centers*

## Data Center Profiler (DC Pro) Tool Training



### DC Pro 3: Tools to Profile and Assess Data Center Energy Efficiency

Sean Morash, Energetics  
Dale Sartor, LBNL  
Neil Wright, Kemtah  
Garrett Speck, Kemtah

April 14, 2015

**FEMP**  
Federal Energy Management Program

[femp.energy.gov](http://femp.energy.gov)

## Data Center

## Master List of Energy Efficiency Measures

Sep. 19, 2014

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# “DC Pro” Data Center On-Line Profiling Tool

## Calculation Reference Manual

This manual describes DC Pro v3.0.

July 28, 2014



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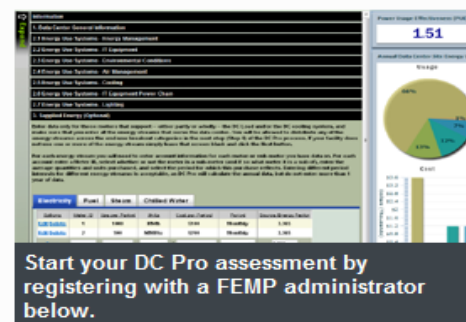
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## Data Center Profiler (DC Pro) Software Tool

### Create a New Account

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Use the form below to create a new account.

Select a User Name

User Name:

Next

## Data Center Profiler (DC Pro) Software Tool

### Create a New Account

Use the form below to create a new account.

Passwords are required to be a minimum of 6 characters in length and 1 non-alphanumeric characters.

#### Account Information

User Name:	<input type="text" value="x"/>	
Password:	<input type="password"/>	Confirm Password: <input type="password"/>
Security Question:	<input type="text"/>	Security Answer: <input type="text"/>
First Name:	<input type="text"/>	Last Name: <input type="text"/>
E-mail:	<input type="text"/>	
Address:	<input type="text"/>	
Address 2:	<input type="text"/>	
City:	<input type="text"/>	State: <input type="text" value="-- Select State --"/>
Zip Code:	<input type="text"/>	
Phone:	<input type="text"/>	Ext: <input type="text"/>
Organization:	<input type="text"/>	
Agency Category:	<input type="text" value="-- Select a Category --"/>	
Comments to Admin:	<input type="text"/>	

Create User



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### Data Center Profiler (DC Pro) Software Tool

#### Log In



If you are using Internet Explorer, you may need to allow both "lbl.gov" and "54.86.8.76" in your Privacy settings.

(Internet Options > Privacy > Sites)

Please enter your username and password. [Register](#) if you don't have an account.

Please [click here](#) if you have forgotten your password.

#### Account Information

Username:

Password:

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
## Data Center Profiler (DC Pro) Software Tool

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
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 [LBNL Test DC - California](#)Welcome rmahdavi! [ [Change Password](#) ] [ [Admin](#) ] [ [Log Out](#) ]

### How to use the tools on this page?

 To begin performing an assessment, navigate the Data Center Explorer on the left side of the page and select a Data Center.If your Data Center is not listed, please [Click Here](#) to add it.

Once selected, you should first add a new DC Profile instance or modify an existing one.

If you have created a Profile using the Data Center Profiler Software Tool, you may export your existing profile to XML, and Import the assessment using the Import DC Profile XML button. Completing a DC Profile instance will generate a set of associated recommended tasks. To view the tasks for an existing instance, click the Task button in the Actions column above. You may delete any Profile using the Delete button in the Actions column. 

## How to use the tools on this page?




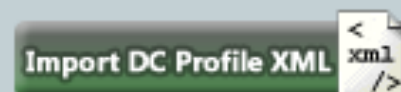
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New data center Button

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Import DC Profile XML



Task Button

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Delete Button

You may delete any Profile using the Delete button in the Actions column.



**Data Centers**

Users

Back to DC Pro

Items

--Add New--  
Berkeley Lab test DC  
CIE  
CIEtest  
DataCenter1

Load

Save

Clear

Delete

\* - required field

**General Info**

Name

Rod workshop test

Street

City

State

Florida

Zipcode

Description

Organization

Labs

Marked for Closure?

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Data Centers

Users

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### Data Center Explorer

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### Rod workshop test

#### DC Profiles

[Import DC Profile XML](#)[Add DC Profile](#)

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[Import DC Profile XML](#)

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[Assessment Home](#) : Rod workshop test Profile | Case: (Baseline)

&gt;&gt;

**Information**

Either click on one of the headers to go to those questions, or click on the 'Continue' button to be taken to the next set of questions.

By clicking on the 'Previous' or 'Next' Section buttons, you will have the option to save your profile and you will be able to exit the application without losing your data.

Items with a Light background contribute to the PUE calculation. Please make sure to answer all of them to get a more accurate calculation.

Clicking on a ? will give you more information about the selected row.

A \* signifies a required field. This is required in order for the report to save, and only exists in the first section.

☐ Is this a Federal Data Center?

[Continue](#)**1.1 Data Center General Information****2.1 Energy Use Systems - Energy Management****2.2 Energy Use Systems - IT Equipment****2.3 Energy Use Systems - Environmental Conditions****2.4 Energy Use Systems - Air Management****2.5 Energy Use Systems - Cooling****2.6 Energy Use Systems - IT Equipment Power Chain****2.7 Energy Use Systems - Lighting****3. Supplied Energy (Optional)****4. Energy Use Distribution (Optional)****5. Results**

Power Usage Effectiveness (PUE)

**Infinity**

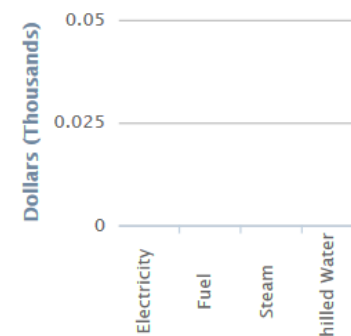
Annual Data Center Site Energy Use

Usage



Equipment Electric Lights Fans Cooling

Cost

[Finish with the Profile](#)[Print Profile](#)[Archive Profile](#)☒ [Generate Recommended Tasks](#)

## Data Center Explorer














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## LBNL Test DC - California



## DC Profiles

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or

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[California](#)**LBNL Test DC - California**

## DC Profiles

Case Name	PUE	Last Updated	Status	Actions
LBNL Test#1 Baseline	3.12	2/28/2014	Completed	 
LBNL Test DC - California-Rod 6/19/13	1.68	12/2/2013	Completed	 
DCEP Class Example	2.77	7/31/2013	Completed	 
DCEP Exam Example	1.51	2/28/2014	Completed	 
GSA Building R	2.09	3/18/2014	Completed	  
LBNL Test DC - California	1.75	9/13/2013	Archived	 

Import DC Profile XML



Add DC Profile



## How to use the tools on this page?



To begin performing an assessment, navigate the Data Center Explorer on the left side of the page and select a Data Center.

If your Data Center is not listed, please [Click Here](#) to add it.

[Assessment Home](#) : LBNL Test DC - California Profile | Case: LBNL Test DC - California

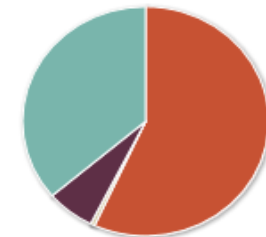


Power Usage Effectiveness (PUE)

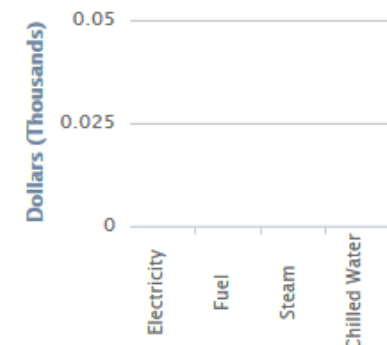
**1.75**

Annual Data Center Site Energy Use

Usage



Cost



## Information

Archived Profile - Read-only.

No changes will be saved.

To continue editing, click the button at the bottom of the page to create a new profile as a copy of the current profile.

☐ Is this a Federal Data Center?

Continue

## 1.1 Data Center General Information

### 2.1 Energy Use Systems - Energy Management

### 2.2 Energy Use Systems - IT Equipment

### 2.3 Energy Use Systems - Environmental Conditions

### 2.4 Energy Use Systems - Air Management

### 2.5 Energy Use Systems - Cooling

### 2.6 Energy Use Systems - IT Equipment Power Chain

### 2.7 Energy Use Systems - Lighting

## 3. Supplied Energy (Optional)

## 4. Energy Use Distribution (Optional)

## 5. Results

Create New Profile Based On This One




## Information

Either click on one of the headers to go to those questions,  
or click on the 'Continue' button to be taken to the next set of questions.

By clicking on the 'Previous' or 'Next' Section buttons, you will have the option to save your profile and you will be able to exit the application without losing your data.

Items with a Light background contribute to the PUE calculation. Please make sure to answer all of them to get a more accurate calculation.

Clicking on a  will give you more information about the selected row.

A \* signifies a required field. This is required in order for the report to save, and only exists in the first section.

☒ Is this a Federal Data Center?

Continue

## 1.1 Data Center General Information

Assessment Home : LBNL Test DC - California Profile | Case: GSA Building R

&gt;&gt;

**Information**

Either click on one of the headers to go to those questions, or click on the 'Continue' button to be taken to the next set of questions.

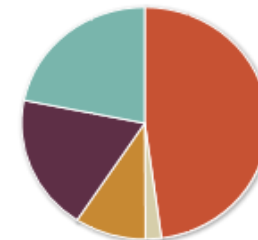
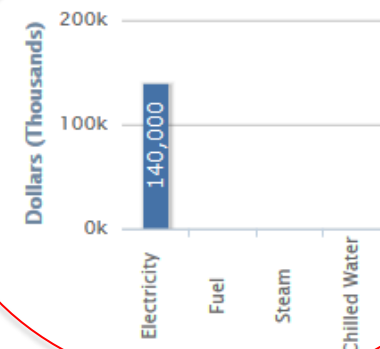
By clicking on the 'Save and Continue' button, your profile will be saved and you will be able to exit the application without losing your data.

Items with a Light background contribute to the PUE calculation. Please make sure to answer all of them to get a more accurate calculation.

Clicking on a ? will give you more information about the selected row.

A \* signifies a required field. This is required in order for the report to save, and only exists in the first section.

☒ Is this a Federal Data Center?

[Continue](#)**1.1 Data Center General Information****1.2 Federal Data Center Consolidation Initiative (FDCCI)****2.1 Energy Use Systems - Energy Management****2.2 Energy Use Systems - IT Equipment****2.3 Energy Use Systems - Environmental Conditions****2.4 Energy Use Systems - Air Management****2.5 Energy Use Systems - Cooling****2.6 Energy Use Systems - IT Equipment Power Chain****2.7 Energy Use Systems - Lighting****3. Supplied Energy (Optional)****4. Energy Use Distribution (Optional)****5. Results****Power Usage Effectiveness (PUE)****2.09****Annual Data Center Site Energy Use****Usage****Cost**[Finish with the Profile](#)[Print Profile](#)[Archive Profile](#)☒ [Generate Recommended Tasks](#)

## 1.1 Data Center General Information

Give the current profile a unique name.  
Use the date to help organize multiple assessments in a datacenter (e.g., "Case #1, 2008-05-31").

\* Profile Name:

\* Department:

\* Organization:

Country:

\* Address:

State/Region:

County:

Climate Zone:

\* Floor Area - Data Center Space:   ?

\* Floor Area - Data Center Support Space:   ?

\* Floor Area - Non Data Center Space:   ?

Total Facility Space:

Type of Data Center:  ?

\* Data Center Tier (Uptime Institute definition):  ?

\* Data Center Class:

This tool currently only supports the USA by default. However, you can choose your climate zone manually by checking this box: ☐

Class as per the ASHRAE Guidelines

Give the current profile a unique name.

Use the date to help organize multiple assessments in a datacenter (e.g., "Case #1, 2008-05-31").

\* Profile Name: GSA Building R

\* Department: DOE

\* Organization: 12

Country: United States of America

This tool currently only supports the USA by default. However, you can choose your climate zone manually by checking this box: ☒

Climate Zone: 5A ▼

\* Floor Area - Data Center Space: 5000 sq feet ▼ ?

\* Floor Area - Data Center Support Space: 500 sq feet ▼ ?

\* Floor Area - Non Data Center Space: 500 sq feet ▼ ?

Total Facility Space: 6000 sq feet ▼

Type of Data Center: Government ▼ ?

\* Data Center Tier (Uptime Institute definition): Tier II ▼ ?

Class as per the ASHRAE

<b>Class</b>	<b>IT equipment type</b>	<b>Recommended operating range</b>	<b>Allowable operating range</b>	<b>Maximum dew point</b>	<b>Environmental control</b>
A1	Enterprise servers, storage products	18° to 27° C [1]	15 to 32° C [2]	17° C	Tightly controlled
A2	Volume servers, storage products, personal computers, workstations	Same as above	10 to 35° C [2]	21° C	Some control
A3	Volume servers, storage products, personal computers, workstations	Same as above	5 to 40° C [3]	24° C	Some control
A4	Volume servers, storage products, personal computers, workstations	Same as above	5 to 45° C [4]	24° C	Some control

**Information****1.1 Data Center General Information**\* Profile Name: \* Department: \* Organization: 

Give the current profile a unique name.

Use the date to help organize multiple assessments in a datacenter (e.g., "Case #1, 2008-05-31").

The four tiers, as classified by The Uptime Institute include the following:

\* Tier I: composed of a single path for power and cooling distribution, without redundant components, providing 99.671% availability.

\* Tier II: composed of a single path for power and cooling distribution, with redundant components, providing 99.741% availability.

\* Tier III: composed of multiple active power and cooling distribution paths, but only one path active, has redundant components, and is concurrently maintainable, providing 99.982% availability.

\* Tier IV: composed of multiple active power and cooling distribution paths, has redundant components, and is fault tolerant, providing 99.995% availability.

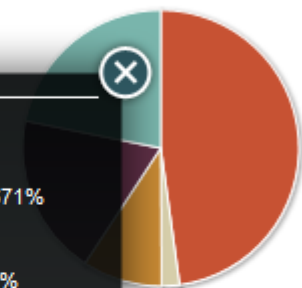
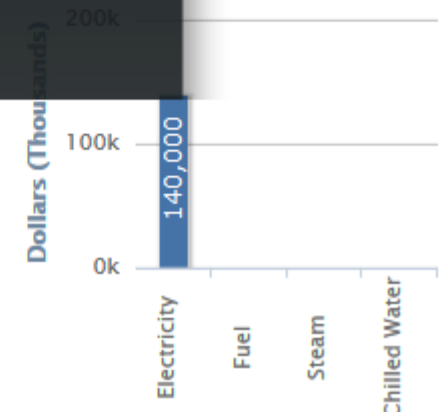
\* Non-Tiered: does not have dedicated cooling and/or power conditioning.

Total Facility Space:  sq feetType of Data Center: 

\* Data Center Tier (Uptime Institute definition):

\* Data Center Class:

Class as per the ASHRAE Guidelines

**Power Usage Effectiveness (PUE)****2.09****Annual Data Center Site Energy Use****Usage****Cost**

## Information

### 1.1 Data Center General Information

Give the current profile a unique name.  
Use the date to help organize multiple assessments in a datacenter (e.g., "Case #1, 2008-05-31").

\* Profile Name:

\* Department:

\* Organization:

Country:

This tool currently only supports the USA.

\* Address:

State/Region:

County:

Climate Zone: 5A

\* Floor Area - Data Center Space:  sq feet

\* Floor Area - Data Center Support Space:  sq feet

\* Floor Area - Non Data Center Space:  sq feet

Total Facility Space:  sq feet

Type of Data Center:

\* Data Center Tier (Uptime Institute definition):

\* Data Center Class:

Class as per the ASHRAE Guidelines

Would you like to save your data before you continue?

Previous Section

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### 1.2 Federal Data Center Consolidation Initiative (FDCCI)

## 2.1 Energy Use Systems - Energy Management

Has an energy audit been conducted within the last 2 years?

☐ Yes ☒ No

Is there a written energy management plan?

☐ Yes ☒ No

Is there an energy measurement and calibration program in place?

☐ Yes ☒ No



Is there a preventative maintenance program in place?

☐ Yes ☒ No

Previous Section

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## 2.2 Energy Use Systems - IT Equipment

## 2.2 Energy Use Systems - IT Equipment

Do you measure and track IT equipment(storage, server and network) utilization?

☐ Yes ☒ No

Do you have a process for identifying abandoned/un-used servers and taking them offline?

☐ Yes ☒ No

What is the average age at which you replace your servers?

4 Years ▼

Are you using virtualization to consolidate your server workloads?

☐ Yes ☒ No

How extensive is your storage consolidation?

1% to 50% ▼

What storage tiers have you implemented?  
(mark all that apply)

- ☒ More than one production tier  
☐ Archiving tier  
☐ Near-line storage

Have you implemented storage optimization techniques such as thin provisioning, incremental snapshots, or de-duplication?

☐ Yes ☒ No

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## 2.3 Energy Use Systems - Environmental Conditions

## 2.3 Energy Use Systems - Environmental Conditions

What is a typical (average) air temperature leaving the cooling coils (supply)?	60F (16C) ▼	?
What is a typical (average) air temperature entering the cooling coils (return)?	70F (21C) ▼	
What is the typical (average) IT equipment intake air temperature?	65F (18C) ▼	?
What is the typical (average) IT equipment exhaust air temperature?	75F (24C) ▼	?
Adopted IT Intake Air Temperature, Maximum:	65F (18C) ▼	Per ASHRAE 2011.
Are the cooling system temperature sensors measuring air conditions that are representative of the IT equipment intake air conditions?	<input type="radio"/> Yes <input checked="" type="radio"/> No	Also include humidity sensors, if any are present.
Does your air management scheme, your economizing system (if present), and your IT equipment allow your data center to operate near the ASHRAE max Recommended IT equipment intake temperature, and occasionally between the ASHRAE max Recommended and max Allowable intake temperature (per your data center Class) during 100% mechanical cooling?	<input type="radio"/> Yes <input checked="" type="radio"/> No	

Do you have active, working  
humidification controls?

☐ Yes ☒ No



Do you have active, working  
dehumidification controls?

☐ Yes ☒ No



Are the current cooling system high  
and/or low humidity limit setpoints for the  
IT intake air tighter than the ASHRAE  
Recommended limits for your data center  
Class?

☐ Yes ☒ No



Do CRAC/H units have centralized  
(networked) or distributed controls?

Distributed ▼



Are CRAC/Hs fighting each other (for  
example, simultaneously humidifying and  
dehumidifying)?

☐ Yes ☒ No



Do the cooling system controls allow you  
to apply correction factors (Slope and  
Offset) to the signals from the  
temperature and humidity sensors?

☐ Yes ☒ No

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## 2.4 Energy Use Systems - Air Management

## 2.4 Energy Use Systems - Air Management

Can your adopted Recommended IT equipment intake air condition be maintained if you turn off one or more selected CRAC/H units?

☐ Yes ☒ No

Is there any supplemental cooling?

None ▼



Does the CRAC/CRAH/AHU have a free cooling coil (water side economizer)?

☐ Yes ☒ No



Is there air-side free cooling?

☐ Yes ☒ No



Air Supply Path

Underfloor Plenum ▼



Is there a floor-tightness (sealing leaks) program in place?

☐ Yes ☒ No



Degree of sealing for cable penetrations?

Poor to None ▼



Is the cable build-up in the floor plenum or the over-head plenum more than 1/3 of the plenum height?

☐ Yes ☒ No



Is there program in place for regularly managing cables to allow unobstructed air flow?

☐ Yes ☒ No



Degree that IT equipment is arranged in rows?

Fair ▼

Is there a rack/lineup-tightness (using blanking panels) program in place? ☐ Yes ☒ No

Degree of current implementation of alternating hot and cold aisles? Fair ▼

Degree that blanking panels are in place? Poor to None ▼

Where is the supply placed? Cold Aisles Only ▼

Is there a diffuser/tile-location (to conserve hot and cold aisles) program in place? ☐ Yes ☒ No

Degree to which hot and cold aisles are currently fully enclosed? Fair ▼

What kind of supply fans are in use? Constant Speed ▼

VSD = Variable Speed Drive

Do some areas of the data center have load densities that are more than 4 times the average load density? ☐ Yes ☒ No

?

Is the air-delivery system balanced to ensure correct airflow rates? ☐ Yes ☒ No

?

Is there an air-balancing (allow proper airflow distribution) program in place? ☐ Yes ☒ No

?

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## 2.5 Energy Use Systems - Cooling

Cooling System Type?

Water-Cooled DX ▼



Condenser cooling system:

Dry Cooler ▼



Type of valves:

3-Way ▼



Do you have premium efficiency motors on all cooling supply fans, pumps, and cooling towers that serve the data center?

☐ Yes ☒ No

What is the redundancy level for HVAC systems?

N+1 ▼



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Next Section

## 2.6 Energy Use Systems - IT Equipment Power Chain

**2.6 Energy Use Systems - IT Equipment Power Chain**

Is there an Uninterruptible Power Supply (UPS)?	<input checked="" type="radio"/> Yes <input type="radio"/> No	If a UPS exists but is not used, answer No.
UPS Technology Type:	Double Conversion ▼	
UPS Size (kVA):	225 ▼	
UPS Voltage:	480 ▼	
What is the average load factor per active UPS module?	40% to 49% ▼	?
UPS Redundancy Configuration	N ▼	?
Is there a standby generator?	<input checked="" type="radio"/> Yes <input type="radio"/> No	?
Standby Generator Power Configuration:	N ▼	
Is there a generator block heater?	<input checked="" type="radio"/> Yes <input type="radio"/> No	
Is there a thermostat on the generator block heater?	<input type="radio"/> Yes <input checked="" type="radio"/> No	
Are there PDUs with built-in transformers?	<input checked="" type="radio"/> Yes <input type="radio"/> No	?
What are the types of MV and LV transformer(s)?	Temp rise 80C ▼	?
Average Load Factor per Active PDUs/Transformers?	25% to 49% ▼	?
What is the load balance between phases?	<=20% ▼	


[Previous Section](#)[Next Section](#)**2.7 Energy Use Systems - Lighting**

## 2.7 Energy Use Systems - Lighting

Lighting power density:   

Lighting Type:

What type of lamps are used?  

What type of ballasts are used?  

How are the lights controlled?

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## 3. Supplied Energy (Optional)

### 3. Supplied Energy (Optional)

Enter data only for those meters that support -- either partly or wholly -- the DC Load and/or the DC cooling system, and make sure that you enter all the energy streams that serve the data center. You will be allowed to distribute any of the energy streams across the end-use breakout categories in the next step (Step 4) of the DC Pro process. If your facility does not use one or more of the energy stream simply leave that screen blank and click the Next button.

For each energy stream you will need to enter account information for each meter or sub-meter you have data on. If you have sub-meters, make sure you do not double count energy. (Either enter the main meter or the separate sub-meters, but not both.)

Electricity

Fuel

Steam

Chilled Water


Options	Meter ID	Use per Period	Units	Cost per Period	Period	
<a href="#">Edit</a> <a href="#">Delete</a>	1	2000	MWh	\$140000	Annually	
<a href="#">Save</a>	<input type="text"/>	<input type="text"/>	<input type="text"/>	\$ <input type="text"/>	<input type="text"/>	

Previous Section

Next Section

### 4. Energy Use Distribution (Optional)

#### 4. Energy Use Distribution (Optional)

Use these screens to allocate the annual energy use for each meter identified in Step 3 across the Energy End-Use Breakout Categories. If you do not know what the allocations are for a given meter, it is OK to skip this screen or enter estimates. 

All of the energy use for a given meter does not have to be allocated to the breakout categories. If the meter serves more than just the data center, it is OK to leave a portion of the energy in the Remainder column.

Once you have entered values for your breakouts, please click the Recalculate button to get your new Totals for each category.

Electricity

Fuel

Steam

Chilled Water

Meter ID	Total Annual Site Energy Use	Site Energy End-Use Breakout Categories										<button>Recalculate</button>
		IT Load		Lights		Electric Distribution Losses		Fans		Cooling & Humidity Controls		Site Ene Related Cer
		kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr
1	2,000,000	920000	46%	40000	2%	180000	9%	363800	18.2%	420000	21%	1,923,800.
Totals		920,000	46%	40,000	2%	180,000	9%	363,800	18.2%	420,000	21%	1,923,80

Previous Section

Next Section

#### 5. Results

Electricity

Fuel

Steam

Chilled Water

Site Energy End-Use Breakout Categories

Recalculate

Meter ID	Total Annual Site Energy Use kWh/yr	IT Load		Lights		Electric Distribution Losses		Fans		Cooling & Humidity Controls		Site Energy Use Related to Data Center		Remainder (Non-Data Center Use)	
		kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%	kWh/yr	%
1	2,000,000	920000	46%	40000	2%	180000	9%	363800	18.2%	420000	21%	1,923,800.00	96.2%	76,200	3.8%
Totals		920,000	46%	40,000	2%	180,000	9%	363,800	18.2%	420,000	21%	1,923,800	96.2%	76,200	3.8%

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## 5. Results

#### 4. Energy Use Distribution (Optional)

Use these screens to allocate the annual energy use for each meter identified in Step 3 across the Energy End-Use Breakout Categories. If you do not know what the allocations are for a given meter, it is OK to skip this screen or enter estimates. ?

All of the energy use for a given meter does not have to be allocated to the breakout categories. If the meter serves more than just the data center, it is OK to leave a portion of the energy in the Remainder column.

Once you have entered values for your breakouts, please click the Recalculate button to get your new Totals for each category.

Electricity

Fuel

Steam

Chilled Water

Meter ID	Total Annual Site Energy Use	Site Energy End-Use Breakout Categories <span>Recalculate</span>					
		Cooling & Humidity Controls		Site Energy Use Related to Data Center		Remainder (Non-Data Center Use)	
		kWh/yr	%	kWh/yr	%	kWh/yr	%
Totals			0%		0%		0%

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#### 5. Results

## 2.7 Energy Use Systems - Lighting

### 3. Supplied Energy (Optional)

### 4. Energy Use Distribution (Optional)

## 5. Results

This is your customized DC Pro Summary Report.

Note: The 'Annual Energy Use' and 'Potential Annual Energy Savings' tables will only have data if you entered data into Sections 3 and 4 (Supplied Energy and Energy Use Distribution).

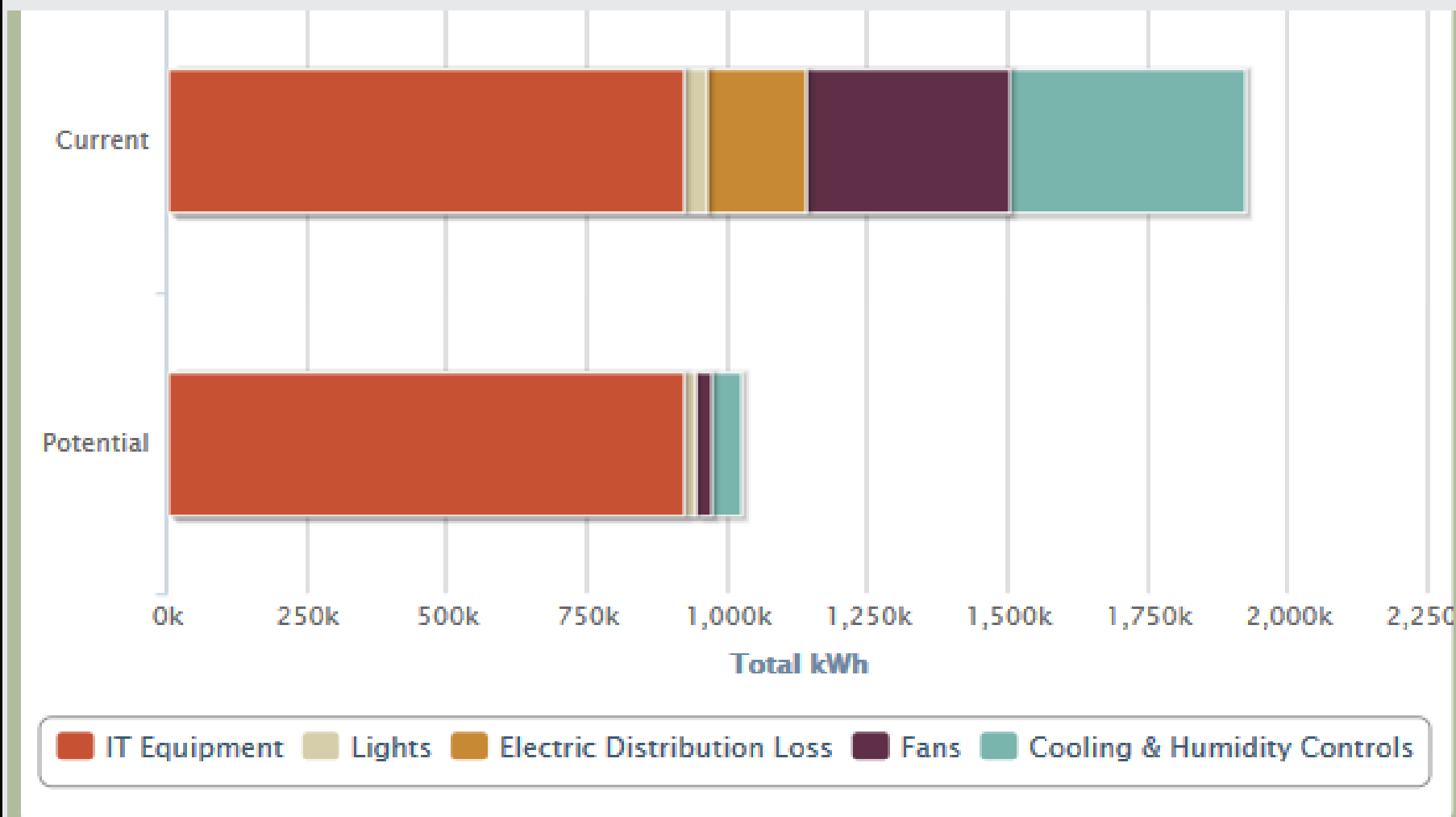
However you can still generate the recommended actions by clicking 'Finish with the Profile' button and making sure the checkbox is checked.

### Annual Energy Use

	Total Amount (in kWh/yr)	\$/yr	\$/kWh
Electricity	1923800	\$140,000.00	\$0.07
Fuel	0	\$0.00	\$0.00
Steam	0	\$0.00	\$0.00
Chilled Water	0	\$0.00	\$0.00
<b>Totals</b>	<b>1923800</b>	<b>\$140,000.00</b>	<b>\$0.07</b>

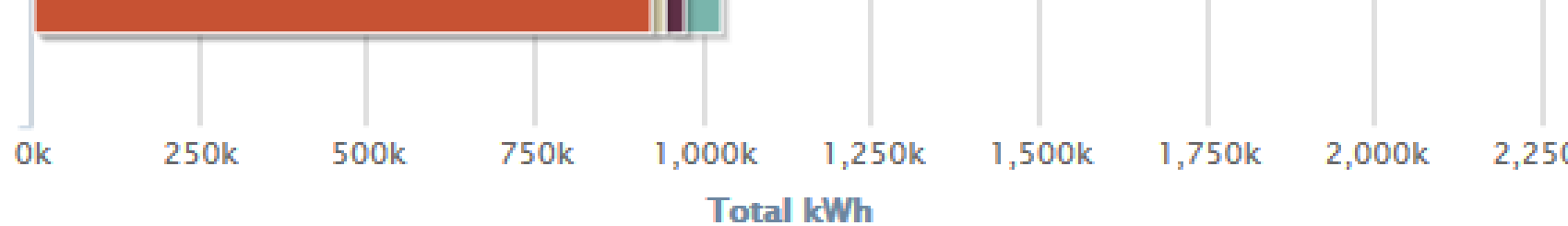
Assessment Home - EBNE Test DO - California Home | Case: USA Building A

>>



### Potential Annual Energy Savings

	Current Energy Use	Potential Energy Use ?	Potential Savings

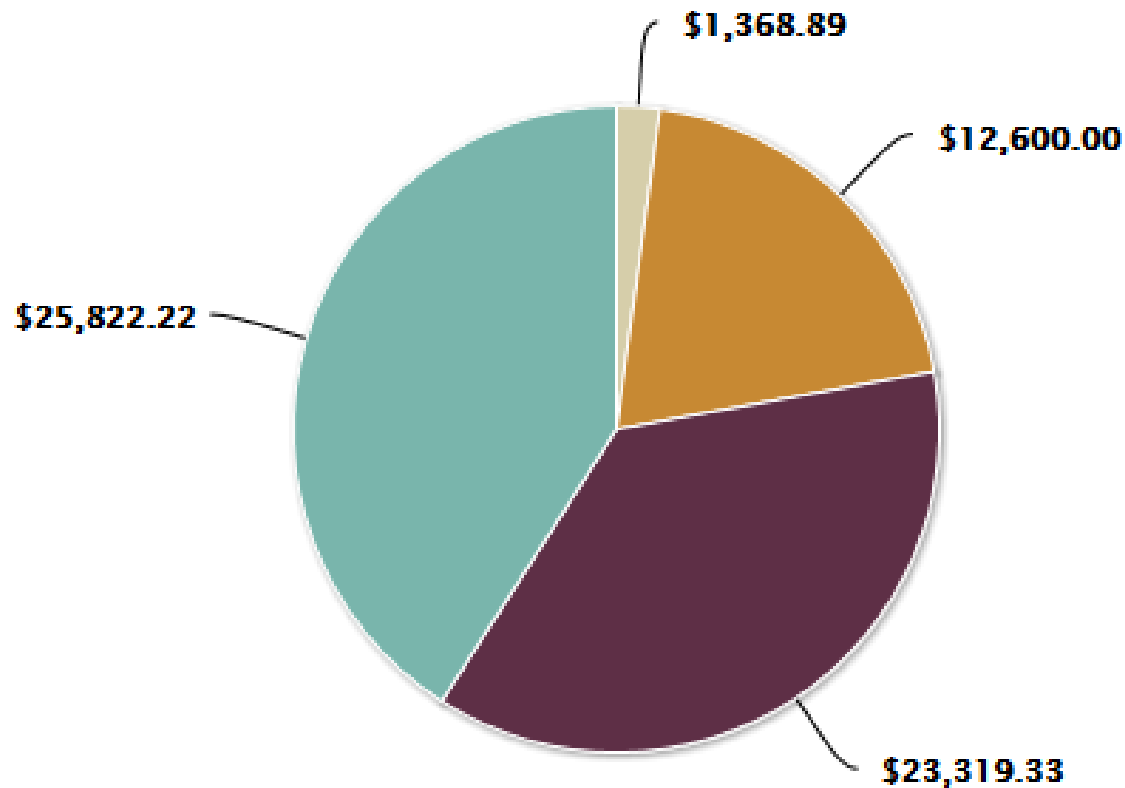


IT Equipment Lights Electric Distribution Loss Fans Cooling & Humidity Controls

### Potential Annual Energy Savings

Breakout Category	Current Energy Use		Potential Energy Use ?		Potential Savings		
	kWh/yr	%	kWh/yr	%	kWh/yr	%	\$
IT Equipment	920000	47.8%	920000	90.0%	0	0%	\$0.00
Data Center Lights	40000	2.1%	20444.44	2.0%	19555.56	1%	\$1,368.89
Electric Distribution Losses	180000	9.4%	0	0.0%	180000	9.4%	\$12,600.00
Fans	363800	18.9%	30666.67	3.0%	333133.33	17.3%	\$23,319.33
Cooling	420000	21.8%	51111.11	5.0%	368888.89	19.2%	\$25,822.22
<b>Totals</b>	<b>1923800</b>	<b>100%</b>	<b>1022222.22</b>	<b>100%</b>	<b>901577.78</b>	<b>46.9%</b>	<b>\$63,110.44</b>
<b>PUE</b>		<b>2.09</b>		<b>1.11</b>			

Total Savings – \$63,110



☐ Lights ☐ Electric Distribution Loss ☐ Fans ☐ Cooling & Humidity Controls

[Finish with the Profile](#)

[Print Profile](#)

[Archive Profile](#)

☒ [Generate Recommended Tasks](#)

>>

Fans	363800	18.9%	30666.67	3.0%	333133.33	17.3%	\$23,319.33
Cooling	420000	21.8%	51111.11	5.0%	368888.89	19.2%	\$25,822.22
Totals	1923800	100%	1022222.22	100%	901577.78	46.9%	\$63,110.44
PUE		2.09		1.11			

Power Usage Effectiveness (PUE)

Annual Data Center Site Energy Use

The page at <http://54.209.27.55> says:  
Are you sure you want to finish this profile?

OK

Cancel

Finish with the Profile

Print Profile

Archive Profile

☒ Generate Recommended Tasks



Section	Task	Description
GL.A.1	Consider upgrading all cooling supply fan, pump, and cooling tower fan motors to premium efficiency.	Premium efficiency motors are generally a few percent more efficient than their baseline counterparts. The efficiency gains are modest, but the incremental first cost tends to be low as well, especially when replacing existing motors that have reached the end of their service life. Specifying a premium efficiency motor is almost always cost effective for applications with long or continuous runtimes.
EM.A.1	Perform an energy audit	The first step towards more energy-efficient operation is to quantify how efficiently your facility is currently operating. An audit will reveal how the total energy use of the facility is distributed among the IT equipment and its support systems -- power distribution, cooling, humidity control, etc. Comparing your results against public benchmark data will indicate the where the best opportunities for cost-effective improvements are.
EM.A.2	Create an energy management plan	Maintaining long-term energy-efficient operation of your facility is best accomplished by creating and executing an Energy Management Plan. This plan will identify who the responsible parties are and what the energy management goals are. It will address how to collect measurements of system performance, how the data is managed and interpreted, and the process of identifying, funding, and implementing energy efficiency actions.
EM.A.3	Assign an energy manager	If your facility does not already have an Energy Manager, consider assigning one. Efforts to improve energy efficiency often falter when there is no clearly identified "champion" to lead and coordinate.
EM.A.4	Engage the upper management with a compelling life-cycle cost case	Some energy efficiency actions have little or no first cost to implement, but many others do. Even if a proposed action has a very rapid payback, management may choose not to fund it based on the cost of implementation. A clearly presented analysis of the return on investment of the proposed action will help management compare it to alternate investment opportunities.
EM.A.5	Implement an energy measurement and calibration program	It is often said "you can't manage what you don't measure". Identify the key parameters of your systems that indicate how well they are performing. Determine which of these parameters are already being monitored and what your recording capabilities are. Add instrumentation to capture the parameters that are currently not monitored. Finally, implement a program to regularly calibrate your sensors to ensure that you always collect accurate readings.
EM.A.6	Conduct regular preventative maintenance	Data center support systems are more likely to operate efficiently when they are kept in tune. It is often the case that a support system is meeting its nominal requirements, there are no alarm conditions, but the system is using more energy that it was designed to. Preventive maintenance will bring these situations to light and correct them before a lot of energy waste occurs.
EM.A.9	Install monitoring equipment to measure system efficiency and performance	If you do not have permanent instruments installed to measure key performance parameters, you can install temporary instruments to obtain the same information for selected periods of time. Electric power meters, chilled water flow meters, and temperature sensors can be quickly deployed and will quantify system performance.
EM.A.10	Raise awareness and develop understanding among Data Center staff about the financial and environment impact of energy savings	Data center staff typically have a list of priorities. Maintaining continuous up-time is usually first, followed by providing capacity for future growth. Energy efficiency is usually third or fourth, at best. Implementing and preserving energy efficient operation is helped by coaching staff on how energy efficiency can increase data center capacity, save money, and support the company's overall environmental goals.

>>

	Impact on energy savings	Center capacity, save money, and support the company's overall environmental goals.
IT.A.1	Start monitoring utilization of servers, storage, and networks to determine whether there are underutilized IT assets and understand your IT capacity growth.	IT systems are often under-utilized. Servers may run at a fraction of their processing capability, data storage may be oversized and infrequently accessed, and network traffic may well below maximum transfer rates. This results in poor energy performance. Monitoring utilization rates will allow data center staff to optimize performance as the data center mission evolves.
IT.A.2	Perform an audit to ensure all operational servers are still in active use.	In a large data center that has been in operation for a while, it is common to have servers that are drawing power but no longer have any assigned tasks. Performing an audit will identify which servers are candidates for shutting down.
IT.A.3	Evaluate the potential savings from upgrading to newer equipment.	IT technology evolves rapidly, and improvements in energy performance are often provided in newer equipment. A cost-benefit analysis will reveal when it makes economic sense to replace existing equipment.
IT.A.4	Investigate using virtualization to consolidate workload and reduce the number of installed servers in your data center. Start gaining experience with new applications and replacement of end-of-life equipment.	Virtualization techniques can consolidate operations on fewer computers, permitting shutting down or eliminating some servers.
IT.A.5	Consider consolidating to network-attached (NAS or SAN) storage and using diskless servers.	Servers typically have on-board mechanical disk drives. These drives are responsible for a significant percentage of the server's total energy use, but they often have a low utilization rate. Converting to solid-state memory at the servers, or consolidating to a network-attached (NAS or SAN) data storage device may be a path to an effective energy performance improvement.
IT.A.7	Consider reducing the capacity requirements for your storage systems.	Your data storage utilization patterns may allow for storage virtualization. In other words, selected processes can be assigned storage limits that, when summed, exceed the actual total provided storage capacity. If the needs of the individual processes for active storage are sufficiently non-coincident, the actual storage limit will rarely or never be exceeded.
EC.A.4	Place temperature/humidity sensors to a good representation of the IT equipment intake air conditions	IT equipment manufacturers design their products to operate reliably within a given range of intake temperature and humidity. The temperature and humidity limits imposed on the cooling system that serves the data center are intended to match or exceed the IT equipment specifications. However, the temperature and humidity sensors are often integral to the cooling equipment and are not located at the IT equipment intakes. The condition of the air supplied by the cooling system is often significantly different by the time it reaches the IT equipment intakes. It is usually not practical to provide sensors at the intake of every piece of IT equipment, but a few representative locations can be selected. Adjusting the cooling system sensor location in order to provide the air condition that is needed at the IT equipment intake often results in more efficient operation.
AM.A.6	Implement a cable management program	Under-floor and over-head obstructions often interfere with the distribution of cooling air. Such interferences can significantly reduce the air handlers' airflow as well as negatively affect the air distribution. The cooling capacity of a raised floor depends on its effective height, which can be increased by removing obstructions that are not in use.



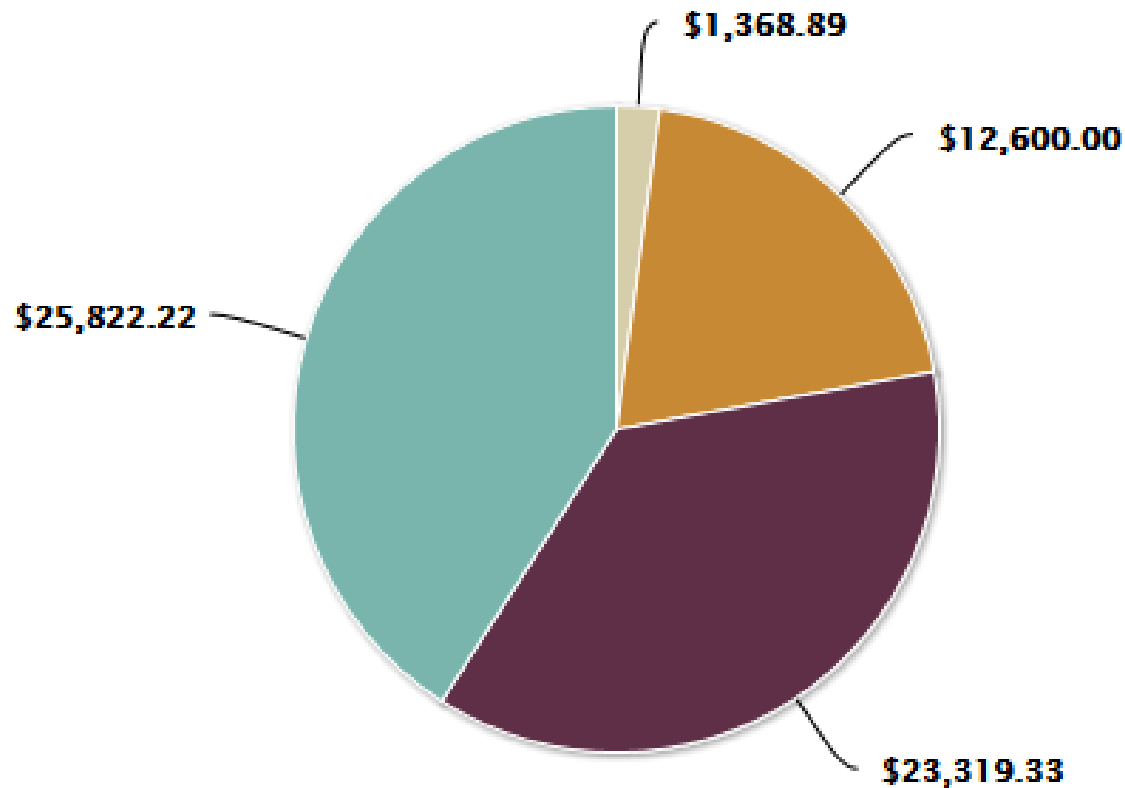
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AM.A.9	Convert to variable speed fans that allow variation of airflow to meet cooling demand	
AM.A.12	Implement a tile/diffuser location program	A program should be in place to maintain the alternating hot and cold aisle configuration of perforated tiles or over-head diffusers. There should be no reason to place tiles or diffusers in the hot equipment aisles.
AM.A.17	Seal floor leaks (including cable cutouts)	
AM.A.18	Implement a floor-tightness program	Raised-floor leakage can be a significant part of the total airflow delivered by the air handler, especially in less dense and lightly populated environments. A well-maintained raised floor results in less air leakage, a higher plenum pressure, and higher flow rates through the perforated floor tiles.
AM.A.21	Use adequate ratio system flow to rack flow (target 1.0 or RTI=100%)	
AM.A.22	Balance the air-distribution system (diffusers/tiles)	Over-head ducted systems can be adequately balanced using conventional methods whereas raised-floor systems are balanced by using "enough" perforated tiles. The latter often becomes more an art rather than science, especially since the pressure difference across the floor is small.
AM.A.27	Maintain tight racks to prevent bypass of air (blanking panels & sealing between racks)	Blanking panels should be used to seal openings under and between equipment racks, between equipment shelves in partially filled racks, or completely empty racks. Managing blanking panels is especially important in hot and cold aisle environments. Blanking panels come in various heights and widths to fit almost any application, and they come in snap-on or screw-in types.
AM.A.28	Implement a rack and lineup tightness program	Any opening between the cold aisle and the hot aisle will degrade the separation of hot and cold air. A program should be in place to minimize leakage by maintaining blanking panels and unbroken lineups.
AM.A.31	Implement an air-balancing program	Generally, the supply flow should closely match the equipment flow. The Return Temperature Index (RTI) is a measure of by-pass air or recirculation air. Both are detrimental to the performance of the data center. The target is 100% whereas >100% implies recirculation air and <100% implies by-pass air.
AM.A.38	Consider adding either an air or waterside economizer to the existing CRAH/AHU(s)	
CP.A.16	Recalibrate CWS temperature sensors.	A water-cooled chiller's efficiency is directly affected by the temperature of the condenser water (CW) entering the condenser. A higher CW supply temperature typically results in lower chiller efficiency, all other factors held equal. An out-of-calibration CW supply temperature sensor can cause the cooling towers to produce a warmer than desired CW temperature and in turn cause the chiller plant to work unnecessarily hard.
ED.A.1	If existing UPS is older than 10 years, retrofit UPS topologies for more efficient ones	UPS technology continues to evolve. If the existing UPS is scheduled for replacement, be sure to specify a high-efficiency UPS topology. If the existing UPS more than 10 years old it may be cost-effective to replace it with a new system right away.
ED.A.15	Standby Generator block heater / heater water jacket(s) (HWJ) operate with	

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ED.A.15	Standby Generator block heater / heater water jacket(s) (HWJ) operate with thermostat control	
ED.A.25	Change UPS DC capacitors if older than 5 years	The DC capacitors in typical UPS systems tend to lose effectiveness over time. This can result in the inverter failing to operate under load, and increased ripple current in the batteries. Not only does this result in less efficient operation, it becomes a safety issue as well. The DC capacitors usually have the same design lifetime as the batteries; approximately 5 years. The capacitors should be checked regularly.
LT.A.2	Install Occupancy Sensors to Control Lights	Many data centers are unoccupied for long periods of time. Controlling the data center lights with occupancy sensors directly saves lighting energy. This also reduces the heat load, saving cooling system energy.
LT.A.3	Consider converting fluorescent lights to LED	
EC.A.12	Consider raising your adopted Recommended max IT equipment intake air temperature to match or exceed the ASHRAE Recommended max for your data center Class	Caveat: Above an IT air intake temperature of around 75F, the speed of the IT equipment's internal cooling fans may increase. The energy penalty for this must be weighed against the energy savings associated with a higher IT intake air temperature.

Total Savings – \$63,110



☐ Lights ☐ Electric Distribution Loss ☐ Fans ☐ Cooling & Humidity Controls

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<b>Data Center Name</b>	<b>PUE</b>
<b>LBNL Test DC - California</b>	<b>2.09</b>

<b>1.1 Data Center General Information</b>	
Profile Name:	GSA Building R
Organization:	DOE
Country:	United States of America
Address:	CA 94720
State/Region:	26
County:	1484
Climate Zone:	5A
Floor Area (sq feet) - Data Center Space:	5000
Floor Area (sq feet) - Data Center Support Space:	500
Floor Area (sq feet) - Non Data Center Space:	500
Total Facility Space:	0 sq feet
Type of Data Center:	Government
Data Center Tier (Uptime Institute definition):	Tier II
Data Center Class:	A1
<b>1.2 Federal Data Center Consolidation Initiative (FDCCI)</b>	
Data Center Function:	General
Ownership Type:	Agency Owned

Fans	303000	16.9%	35401.0	9.1%	200330.2	13.9%	\$10,703.07
Cooling	420000	21.8%	32519.95	3.1%	387480.05	20.1%	\$27,123.60
Totals	1923800	100%	1049030.787	100%	874769.22	45.4%	\$61,233.85
PUE		2.09		1.14			

Total Savings – \$61,234

\$2,726.57

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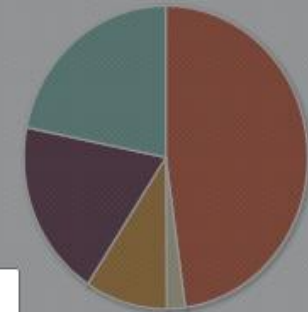
OK

Cancel

\$27,123.60

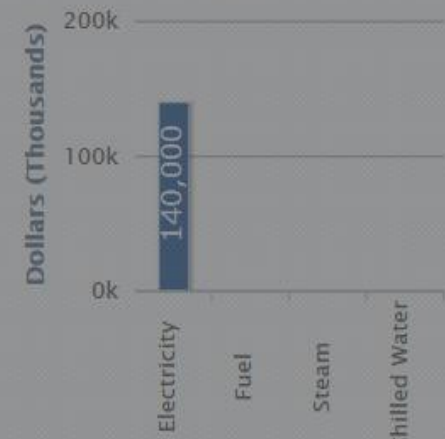
\$18,783.67

Lights Electric Distribution Loss Fans Cooling & Humidity Controls



Equipment Lights  
Electric Fans Cooling

Cost



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- Expert Instructors
- Self paced
- CEUs



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- Advanced HVAC in High-Tech Buildings - Laboratories
- Labs, Data Centers, and High-Tech Facilities
- Achieving Energy-Efficient Data Centers with New ASHRAE Thermal Guidelines

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- Regular offerings
- Registration Cost

<http://datacenters.lbl.gov/dcep>



U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

Thank you!

Questions?

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FEMP Data Center Program Lead

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